CLAIMS

What is claimed is:

1. A fixed terrestrial user terminal antenna for satellite communication systems in which satellites orbit earth in a constellation comprised of a plurality of spaced orbital planes with each orbital plane of the plurality of orbital planes having a plurality of satellites, the user terminal antenna comprising:

a base, the base providing support for the user terminal antenna;

a tilt plate, the tilt plate being connected to the base and being capable of being tilted relative to the base; and

a 1-dimensional electronically scanned phased array antenna that scans along a single scan axis, the array antenna being attached to the tilt plate so that the array antenna tilts with the tilting of the tilt plate, and the array antenna tracking individual satellites of the plurality of satellites in an orbital plane of the plurality of orbital planes as the individual satellites travel through a field of view of the array antenna so that the array antenna can transmit data to and receive data from the individual satellites.

2. The user terminal antenna of claim 1, wherein:

the scan axis of the array antenna is oriented to be generally aligned with the orbits of the plurality of satellites in the plurality of orbital planes so that the array antenna can track a first satellite of the plurality of satellites in a first orbital plane of the plurality of orbital planes as the first satellite in the first orbital plane travels through the field of view of the array antenna.

3. The user terminal antenna of claim 2, wherein:

the array antenna switches from tracking the first satellite in the first orbital plane to tracking a second satellite of the plurality of satellites in the first orbital plane when the first satellite in the first orbital plane reaches a predetermined satellite release location in the field of view of the array antenna.

4. The user terminal antenna of claim 3, wherein:

the array antenna switches from tracking the first satellite in the first orbital plane to tracking the second satellite in the first orbital plane by retracing the first orbital plane to a predetermined satellite acquisition location.

5. The user terminal antenna of claim 2, wherein:

the tilt plate tilts about a single tilt axis that is generally aligned with the scan axis.

6. The user terminal antenna of claim 2, wherein:

the tilt plate tilts about a single tilt axis; and

the tilt plate tilts about the tilt axis as the array antenna tracks the first satellite in the first orbital plane, the tilting of the tilt plate compensating for rotation of the earth so that the field of view of the array antenna remains oriented toward the first orbital plane and the array antenna is capable of transmitting data to and receiving data from the first satellite in the first orbital plane.

7. The user terminal antenna of claim 2, wherein:

the tilt plate tilts about a single tilt axis; and

the tilt plate tilts about the tilt axis to a predetermined orbital plane acquisition location when the array antenna switches from tracking individual satellites of the plurality of satellites in the first orbital plane to tracking individual satellites of the plurality of satellites in a second orbital plane of the plurality of orbital planes, the tilting of the tilt plate to the predetermined orbital plane acquisition location causing the field of view of the array antenna to be oriented toward the second orbital plane of the plurality of orbital planes so that a first individual satellite of the plurality of satellites in the second orbital plane of the plurality of orbital planes can be tracked and data transmitted to and received from the first individual satellite in the second orbital plane.

8. The user terminal antenna of claim 2, wherein:

the array antenna is a dual feed array antenna so that the array antenna can simultaneously transmit and receive data.

9. The user terminal antenna of claim 2, wherein:

the array antenna has separate transmission and reception apertures, and the transmission aperture transmitting data to and the reception aperture receiving data from the individual satellites being tracked by the antenna array.

10. The user terminal antenna of claim 2, wherein:

the orbits of the plurality of satellites in the plurality of orbital planes are polar orbits;

the array antenna is oriented so that the scan axis generally extends North and South; and

the tilt plate tilts about a single tilt axis that is generally aligned with the scan axis.

11. The user terminal antenna of claim 2, wherein:

the plurality of spaced orbital planes are equally spaced apart.

12. The user terminal antenna of claim 2, wherein:

the array antenna has an aperture with a width and a length, the aperture length extending along the scan axis with the aperture width being generally perpendicular to the aperture length, and the aperture length being greater than the aperture width.

13. The user terminal antenna of claim 12, wherein:

the aperture width is dimensioned so that a width of an antenna beam produced by the array antenna compensates for curvature of the orbits of the plurality of satellites in the plurality of orbital planes.

14. A method of using a terrestrial user terminal antenna having a one dimensional electronically scanned phased array antenna with a single scan axis that is attached to a tilt plate that tilts about a single tilt axis to communicate with a satellite communication system in which satellites orbit earth in a constellation comprised of a plurality of spaced orbital planes with each orbital plane of the plurality of orbital planes having a plurality of satellites, the method comprising the steps of:

orienting the user terminal antenna so that the scan axis of the array antenna is generally aligned with orbits of the plurality of satellites in the plurality of orbital planes;

acquiring a first satellite of the plurality of satellites in a first orbital plane of the plurality of orbital planes that is in a field of view of the array antenna;

tracking the first satellite in the first orbital plane while the first satellite in the first orbital plane travels through the field of view of the array antenna as the first satellite in the first orbital plane orbits the earth; and

transmitting data to and receiving data from the first satellite in the first orbital plane while the array antenna is tracking the first satellite in the first orbital plane.

15. The method of claim 14, further comprising the step of:

tilting the tilt plate to a predetermined orbital plane acquisition location so that the field of view of the array antenna is oriented toward the first orbital plane of the plurality of orbital planes prior to performing the step of acquiring a first satellite.

16. The method of claim 15, wherein the step of tracking the first satellite includes the step of:

tilting the tilt plate about the tilt axis as the array antenna tracks the first satellite in the first orbital plane so that the field of view of the array antenna remains oriented toward the first orbital plane while the array antenna tracks the first satellite in the first orbital plane.

17. The method of claim 16, wherein the step of tracking the first satellite includes the steps of:

tracking the first satellite in the first orbital plane until the first satellite in the first orbital plane is at a predetermined satellite release location;

releasing the first satellite in the first orbital plane by ceasing to track the first satellite in the first orbital plane as the first satellite in the first orbital plane continues to travel past the predetermined satellite release location;

acquiring a second satellite of the plurality of satellites in the first orbital plane by scanning with the array antenna to a predetermined satellite acquisition location;

tracking the second satellite in the first orbital plane as the second satellite in the first orbital plane orbits the earth in the first orbital plane and travels through the field of view of the array antenna between the predetermined satellite acquisition location and the predetermined satellite release location; and

the step of transmitting data to and receiving data from the first satellite further comprises transmitting data to and receiving data from any satellite of the plurality of satellites in any orbital plane of the plurality of orbital planes that is being tracked by the array antenna.

18. The method of claim 17, further comprising the step of:

releasing the second satellite in the first orbital plane when the second satellite in the first orbital plane is at the predetermined satellite release location; and

wherein the steps of acquiring, tracking, and releasing a first satellite in the first orbital plane and then acquiring, tracking, and releasing a second satellite in the first orbital plane repeats for each satellite of the plurality of satellites in the first orbital plane until the first orbital plane is at a predetermined orbital plane release location.

19. The method of claim 18, further comprising the steps of:

releasing the first orbital plane by ceasing to track any satellite of the plurality of satellites in the first orbital plane when the first orbital plane is at the predetermined orbital plane release location;

tilting the tilt plate about the tilt axis to the predetermined orbital plane acquisition location when the first orbital plane is at the predetermined orbital plane release location so that the field of view of the array antenna is oriented toward a second orbital plane of the plurality of orbital planes; and

wherein the steps of acquiring, tracking, and releasing each satellite of the plurality of satellites in the first orbital plane are performed for each satellite of the plurality of satellites in the second orbital plane while the second orbital plane is between the predetermined orbital plane acquisition location and the predetermined orbital plane release location.

20. The method of claim 19, wherein the step of transmitting and receiving data includes the steps of:

negotiating a data transfer protocol prior to switching from tracking an individual satellite of the plurality of satellites in the first orbital plane to tracking an individual satellite of the plurality of satellites in the second orbital plane so that no data is lost due to the switching.